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Status Report
NASA Contract R-126/06-06-013
Ionospheric Electron Density Studies and Computations

November 1, 1964 - June 30, 1965

Introduction

NASA Contract R-126/06-06-013 provides for research and data analysis in the application of ground-based radio ionospheric measurements to NASA programs in aeronomy. Emphasis is placed in four primary areas: (1) Research concerning methods of radio ionospheric measurement and data analysis having direct pertinence to the needs of particular rocket/satellite programs in aeronomy. (2) Data analysis and consultation in applications of ground-based radio ionospheric measurements for NASA and NASA-supported rocket-probe and satellite programs in aeronomy. (3) Development of a reliable and complete climatology describing the structure and variations of the ionosphere, so that individual rocket and satellite experimental results may be placed in the context of geographic, diurnal, seasonal, and solar-cycle variations of the atmosphere. (4) A small research effort to use the data and facilities of the program in studies of E and F region physical processes. This report summarizes our activities in these categories during the period November 1964 - June 30, 1965.

1) Development of Analysis Methods: Although the principle equations of the ionogram/ $N(h)$ profile problem may be said to have a satisfactory treatment by the methods developed so far, there remains uncertainty concerning the resolution of "valley ambiguities" and nighttime "underlying ionization". Only for the latter problem does it appear that present methods of correction give accurate answers, and then only with ionospheric soundings of uncommonly high quality. This verification has resulted from a number of recent NASA rocket flights at Wallops Island. For the former "valley" problem, an attempt is being made to assess quantitatively the information actually available; this is being done by a generalization of the so-called "Abel Solution" of the principle integral equation.

Currently a revision of the main analysis program is necessary for the new computing facilities at NBS. This should lower computation costs and permit us to offer the program to other users in a generally-useful computer language.

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2) Data Analysis and Consultation for Specific Applications: In the current period we have provided electron density profile data, and consultation in their use, to the following Agencies and organizations:

Air Force Cambridge Research Laboratories

NASA

Ames Research Center
Goddard Space Flight Center
NASA Data Center (GSFC)
Lewis Research Center

Geophysics Corporation of America

Illinois Institute of Technology Research Institute

Jet Propulsion Laboratory

Pennsylvania State University

TRW Space Technology Labs

University of Birmingham (England)

University of Illinois

University of Michigan

University of New Hampshire

Applications of the data supplied to these users have been quite varied, and range from refraction-correction data for the Mariner IV program and planning data for the NASA Mobile Launch Expedition, through special calculations for GSFC theoretical studies of the equatorial ionospheric anomaly, to detailed profile calculations for many specific rocket flights at Wallops Island, Fort Churchill, and White Sands.

3) Development and Applications of an Ionospheric Climatology: From the systematic radio soundings of the ionosphere principally along the 75°W meridian, we are obtaining profile computations to represent the seasonal, diurnal, and geographical structure of the ionosphere at solar-minimum. Approximately 20 stations contribute data for this purpose. The results are being used to examine several theoretical descriptions of ionospheric production/loss/movement processes at NBS, Pennsylvania State University, and NASA (Ames Research Center).

4) Studies of Ionospheric Physical Processes: A study of the nightglow-ionospheric variation problem has been completed by Dr. Peterson; this consists of a theoretical treatment (with NBS colleagues) and an analysis of data from Hawaii. Although reasonable agreement is found with theory, a residual nightglow background remains unexplained. The analysis method is applied to ITRI airglow and NBS profile data obtained during the NASA Mobile Launch Expedition.

Dr. T. Shimazaki is examining ionospheric variations using NASA rocket data on atmospheric and ionospheric compositions, together with N(h) profile data obtained in the present program, to identify the movement-processes involved. This is principally a time-dependent problem, and utilizes the main advantages of radio sounding data (which may be continuous in time) and of rocket data (which obtain much more varied physical data). A recent paper treats the nighttime case where temperature alone is permitted to vary, and its effects on the rates of loss and diffusion are examined along the 75°W meridian; it is found, as expected, that other movement processes must be invoked.